# UNITED STATES PATENT AND TRADEMARK OFFICE

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 09/965,757 | 09/28/2001 | Youfeng Wu | 42390P10792 | 2970 |

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| 8791 | 7590 | 08/13/2004 | |

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| EXAMINER |
|---|
| FOWLKES, ANDRE R |

| ART UNIT | PAPER NUMBER |
|---|---|
| 2122 | |

DATE MAILED: 08/13/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

> A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE _3_ MONTH(S) FROM
> THE MAILING DATE OF THIS COMMUNICATION.
> - Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed
>   after SIX (6) MONTHS from the mailing date of this communication.
> - If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
> - If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
> - Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
>   Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any
>   earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1) ☒ Responsive to communication(s) filed on _12 March 2002_.

2a) ☐ This action is **FINAL**.     2b) ☒ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is

closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4) ☒ Claim(s) _1-17_ is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5) ☐ Claim(s) _____ is/are allowed.

6) ☒ Claim(s) _1-17_ is/are rejected.

7) ☒ Claim(s) _16_ is/are objected to.

8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9) ☐ The specification is objected to by the Examiner.

10) ☒ The drawing(s) filed on _28 September 2001_ is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a) ☐ All   b) ☐ Some * c) ☐ None of:

1. ☐ Certified copies of the priority documents have been received.

2. ☐ Certified copies of the priority documents have been received in Application No. _____.

3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage

application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _9/28/01_.

4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

## DETAILED ACTION

1.      Claims 1-17 are pending.


### *Drawings*

2.      The drawings are objected to because the drawings are informal.  Corrected

drawing sheets are required in reply to the Office action to avoid abandonment of the

application.  Any amended replacement drawing sheet should include all of the figures

appearing on the immediate prior version of the sheet, even if only one figure is being

amended.  The figure or figure number of an amended drawing should not be labeled as

"amended."  If a drawing figure is to be canceled, the appropriate figure must be

removed from the replacement sheet, and where necessary, the remaining figures must

be renumbered and appropriate changes made to the brief description of the several

views of the drawings for consistency.  Additional replacement sheets may be

necessary to show the renumbering of the remaining figures.  The replacement sheet(s)

should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so

as not to obstruct any portion of the drawing figures.  If the changes are not accepted by

the examiner, the applicant will be notified and informed of any required corrective

action in the next Office action. The objection to the drawings will not be held in

abeyance.

### *Claim Objections*

3.      Claim 16 is objected to because of the following informalities:  "The method of

claim 1, further comprises" should be – The method of claim 9, further comprises – on

line 1 of claim 16.  Appropriate correction is required.

### *Claim Rejections - 35 USC § 103*

4.      The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set
> forth in section 102 of this title, if the differences between the subject matter sought to be patented and
> the prior art are such that the subject matter as a whole would have been obvious at the time the
> invention was made to a person having ordinary skill in the art to which said subject matter pertains.
> Patentability shall not be negatived by the manner in which the invention was made.

5.      Claims 1-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over

Lowry et al. (Lowry), "Object Code Optimization", Communications of the ACM, in view

of Chang et al. (Chang), "Using Profile Information to Assist Classic Code

Optimizations", Software—Practice & Experience.

        As per claim 1, Lowry discloses a **system comprising a compiler to generate

object code from a computer program, a code optimizer to optimize the object

code generated by the compiler** (p. 13 col. L:46 - col. R:3, "(the) compiler performs

the most thorough analysis of source code and produces the most efficient (optimized)

object code"), **the code optimizer including:**

- **a first device to formulate regions** (p. 14 col. L:17-18, "the program is broken into computational 'blocks' (i.e. regions)"),

- **a second device to select initial regions** (p. 14 col. L:17-18, "the program is broken into computational 'blocks' (and the regions are selected)"),

- **a third device to apply code motion** (p. 21 col. L:29-30, "Elimination of unnecessary unconditional braches by reordering the code"),

- **a fifth device to compute UEU(E,R) and DED(X,R), wherein UEU(E,R) represents a number of upward exposed registers at a main entry E of a region R that are used in the region R and DED(X,R) represents a number of downward exposed registers at a main exit X of the region R that are defined in the region R** (p. 20 col. R:20-30, The number of upward exposed registers, UEU(E,R), and the number of downward exposed registers, DED(X,R), are computed for each command, and notated as follows: "11—The operand is available in a register and it must be retained in that register after the operation (i.e. UEU(E, R)), and 00—The operand must be fetched from storage and retained in a register after the operation (i.e. DED(X,R))"),

- **a memory to store the compiler and the code optimizer, and a central processing unit (CPU) cooperatively connected to the memory to execute the compiler and the code optimizer** (p. 22 col. R:26-27, "storage (i.e. memory) speed and ... CPU's").

Lowry doesn't explicitly disclose **a fourth device to apply tail duplication.** However, Chang, in an analogous environment, discloses **a fourth device to apply tail duplication** (p. 13:4-5, "More code transformations are applied after tail duplication").

Therefore, it would have been obvious to a person of ordinary skill in the art, at the time the invention was made, to incorporate the teachings of Chang into the system of Lowry to apply tail duplication. The modification would have been obvious because one of ordinary skill in the art would have wanted to use the well-known technique of tail duplication to further optimize the program code.

As per claim 2, the rejection of claim 1 is incorporated and further, Lowry discloses that **the second device selects initial regions by selecting sub-control flow graphs as regions such that the region starts execution mostly at the main entry and completes mostly at the main exit** (p. 14 col. L:15-40, "the program is broken into computational 'blocks' ... Each block consists of a sequence of statements, only the first of which may be branched to (i.e. execution starts at the main entry), and only the last of which contains a branch (i.e. execution completes at the main exit)").

As per claim 3, the rejection of claim 1 is incorporated and further, Lowry discloses that **the fifth device computes UEU(E,R) and DED(X,R) using local information from the region R** (p. 20 col. R:20-30, The number of upward exposed registers, UEU(E,R), and the number of downward exposed registers, DED(X,R), are

computed for each command and notated as follows: "11—The operand is available in a register and it must be retained in that register after the operation (i.e. UEU(E, R)), and 00—The operand must be fetched from storage and retained in a register after the operation (i.e. DED(X,R))").

As per claim 4, the rejection of claim 1 is incorporated and further, Lowry discloses that **the third device applies code motion by moving instructions outside the region R into the region R** (p. 21 col. L:29-30, "Elimination of unnecessary unconditional branches by reordering the code (i.e. code motion)", and code motion is used to move instructions to/from the entry, interior, and/or exit of a region, R).

As per claim 5, the rejection of claim 4 is incorporated and further, Lowry discloses that **the third device moves instructions outside of the region R into the main entry E and the main exit X of the region R** (p. 21 col. L:29-30, "Elimination of unnecessary unconditional branches by reordering the code (i.e. code motion)", and code motion is used to move instructions to/from the entry, interior, and/or exit of a region, R).

As per claim 6, the rejection of claim 5 is incorporated and further, Lowry discloses that **the third device moves instructions outside of the region R into the main entry E and the main exit X of the region R, and later moves the instructions from the main entry E and the main exit X of the region R to other places inside**

the region R (p. 21 col. L:29-30, "Elimination of unnecessary unconditional branches by reordering the code (i.e. code motion)", and code motion is used to move instructions to/from the entry, interior, and/or exit of a region, R).

As per claim 7, the rejection of claim 1 is incorporated and further, Lowry doesn't explicitly disclose that **the fourth device applies tail duplication to separate reusable instructions executed along a side entry after selection of initial regions**.

However, Chang, in an analogous environment, discloses that **the fourth device applies tail duplication to separate instructions executed along a side entry after selection of initial regions** (p. 13:2-3, "we duplicate the tail part of the ... trace (to separate the instructions)").

Therefore, it would have been obvious to a person of ordinary skill in the art, at the time the invention was made, to incorporate the teachings of Chang into the system of Lowry to apply tail duplication to separate the instructions. The modification would have been obvious because one of ordinary skill in the art would have wanted to use the well-known technique of tail duplication to separate the instructions and then further optimize the program code.

As per claim 8, the rejection of claim 1 is incorporated and further, Lowry doesn't explicitly disclose that **the fourth device applies tail duplication during application of code motion**.

However, Chang, in an analogous environment, discloses that **the fourth device applies tail duplication during application of code motion** (p. 13:4-5, "More code transformations (i.e. code motion) are applied after tail duplication").

Therefore, it would have been obvious to a person of ordinary skill in the art, at the time the invention was made, to incorporate the teachings of Chang into the system of Lowry to apply tail duplication during code motion. The modification would have been obvious because one of ordinary skill in the art would have wanted to use the well-known techniques of tail duplication and code motion to further optimize program code.

As per claims 9-17, the Lowry/Chang combination also discloses such claimed limitations as addressed in claims 1-8 above, respectively.
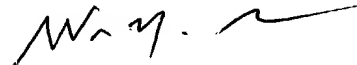
### *Conclusion*

6.     Any inquiry concerning this communication or earlier communications from the examiner should be directed to Andre R. Fowlkes whose telephone number is (703)305-8889. The examiner can normally be reached on Monday - Friday, 8:00am-4:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tuan Q. Dam can be reached on (703)305-4552. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the

Patent Application Information Retrieval (PAIR) system.  Status information for

published applications may be obtained from either Private PAIR or Public PAIR.

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you have questions on access to the Private PAIR system, contact the Electronic

Business Center (EBC) at 866-217-9197 (toll-free).

ARF

**WEI Y. ZHEN**
**PRIMARY EXAMINER**